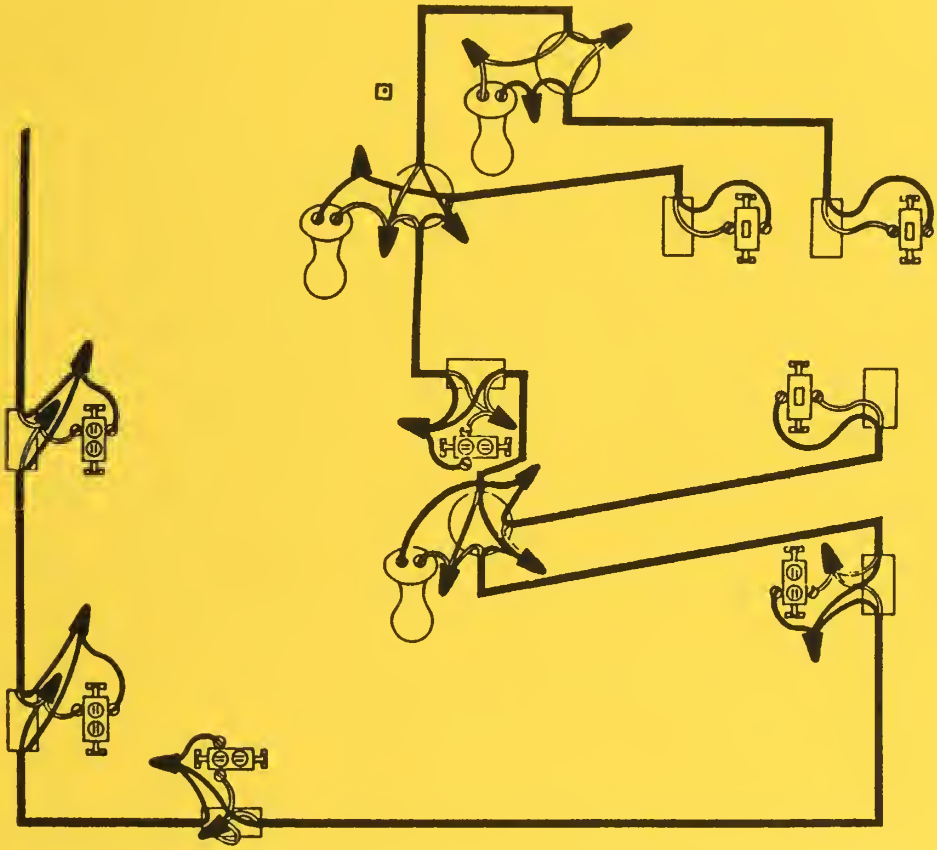
ELECTRICITY

12-22-32



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INDUSTRIAL EDUCATION

Curriculum Guide

Alberta
EDUCATION
1982

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ELECTRICITY

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NOTE: This Curriculum Guide is a service publication only. The Senior High School Program of Studies contains the official statement concerning Senior High School courses. The information contained in the guide is prescriptive insofar as it duplicates that contained in the Program of Studies. There are in the Guide, however, as well as content, methods of developing the concepts, suggestions for the use of teaching aids and lists of additional reference books.

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INDUSTRIAL EDUCATION

RATIONALE

Industrial Education is a program consisting of courses which provide a continuum of experiences, starting with exploratory activities in the junior high school and expanding in the high school to the development of skills related to career fields. This development of the student's skills is planned for through courses in industrial and vocational education culminating in on-the-job work experience, or entry into a job or post-high school institution for further education.

The program consists of courses ranging from those designed for an exploration of the technologies and trade areas to units of practical preparation for a career. In the process the courses develop the student's self-knowledge, talents and skills.

For information on sequencing and course description, refer to the "Handbook In Industrial Education for Guidance to Teachers, Counsellors and Administrators".

PROGRAMS

There are two parts to the Industrial Education program. The first part consists of the I.E. 10, 20, 30 series of courses and is designed for career orientation. These courses were developed primarily for students in laboratories that utilize the multiple activity approach as found in most smaller schools, but they can be taught in unit shops as well.

The second part consists of the I.E. 12, 22, 32 series of courses and is intended for career development. The courses are planned for use in schools where facilities are available to teach specific occupational areas.

Students may progress from the I.E. 10, 20, 30 series to the 22 level courses upon meeting specified basic prerequisites or upon recommendation of their principal.

Both sections of the program focus on seven career fields. These are:

Graphic Communications
Mechanics
Construction and Fabrication
Electricity-Electronics
Personal Services
Performing Arts
Horticulture

The I.E. 10, 20, 30 courses consist of a number of one credit modules related to the career fields while the I.E. 12, 22, 32 courses consist of a number of five credit modules of specific occupational content. Completion of seven five credit modules qualifies the student for recognition by the Apprenticeship Branch for credit towards a journeyman's certificate.

It is left to the administrators of the school to offer the courses or combination of courses best suited to the needs and interests of the students and the financial resources of the district.

Courses offered at the 22 and 32 level have to meet special criteria for staff and facilities. The Industrial Education Consultant must authorize these in order to qualify the students for vocational grants.

OBJECTIVES OF INDUSTRIAL EDUCATION

The Industrial Education Program can help achieve the Goals of Schooling and Education. The course objectives are more focused and give direction to the teacher.

The objectives of Industrial Education are classified in three areas with the following purposes:

A. Personal Growth:

To provide opportunities for the individual growth of the student through the development of acceptable personal and social values necessary in a productive society.

1. To provide a technical environment which motivates and stimulates individuals to discover their interests and develop personal and social responsibilities.

2. To assist in the development of positive attitudes toward safety.

3. To assist in the development of positive attitudes toward conservation and environment.

4. To assist in the development of consumer literacy.

B. Career Exploration:

To develop basic competencies, integrating cognitive and psychomotor skills to enter a family of occupations or post-secondary institutions for further education.

1. To provide exploratory experiences in the use of tools, equipment and materials appropriate to various technologies prevalent in a productive society.

2. To develop an understanding of the interrelationship of various technologies.

3. To provide a technical environment for students to synthesize their accumulated knowledge in the solution of practical problems.

4. To assist the student to develop habits that will be conducive to the establishment of a safe environment.

C. Occupational Skills:

To develop basic competencies, integrating cognitive and psychomotor skills related to families of occupations.

1. To provide safe exploratory experiences in the use of tools, energy, equipment and materials appropriate to various technologies prevalent in a productive society.

2. To develop an understanding of the interrelationships of various technologies.

3. To provide a technical environment which permits students to synthesize their accumulated knowledge in the solution of practical problems, and to assist students to develop habits that will be conducive to the establishment of a safe environment.

INDUSTRIAL EDUCATION 12, 22, 32 PROGRAM

INTRODUCTION

The Industrial Education 12, 22, 32 program is a series of modules which develop competencies leading to seven different career fields.

Entry into a career field may be gained by taking one of several introductory courses. These are:

1. the "12" course designated for each major, or

2. two modules from the Industrial Education "10, 20, 30" series related to the anticipated major, or

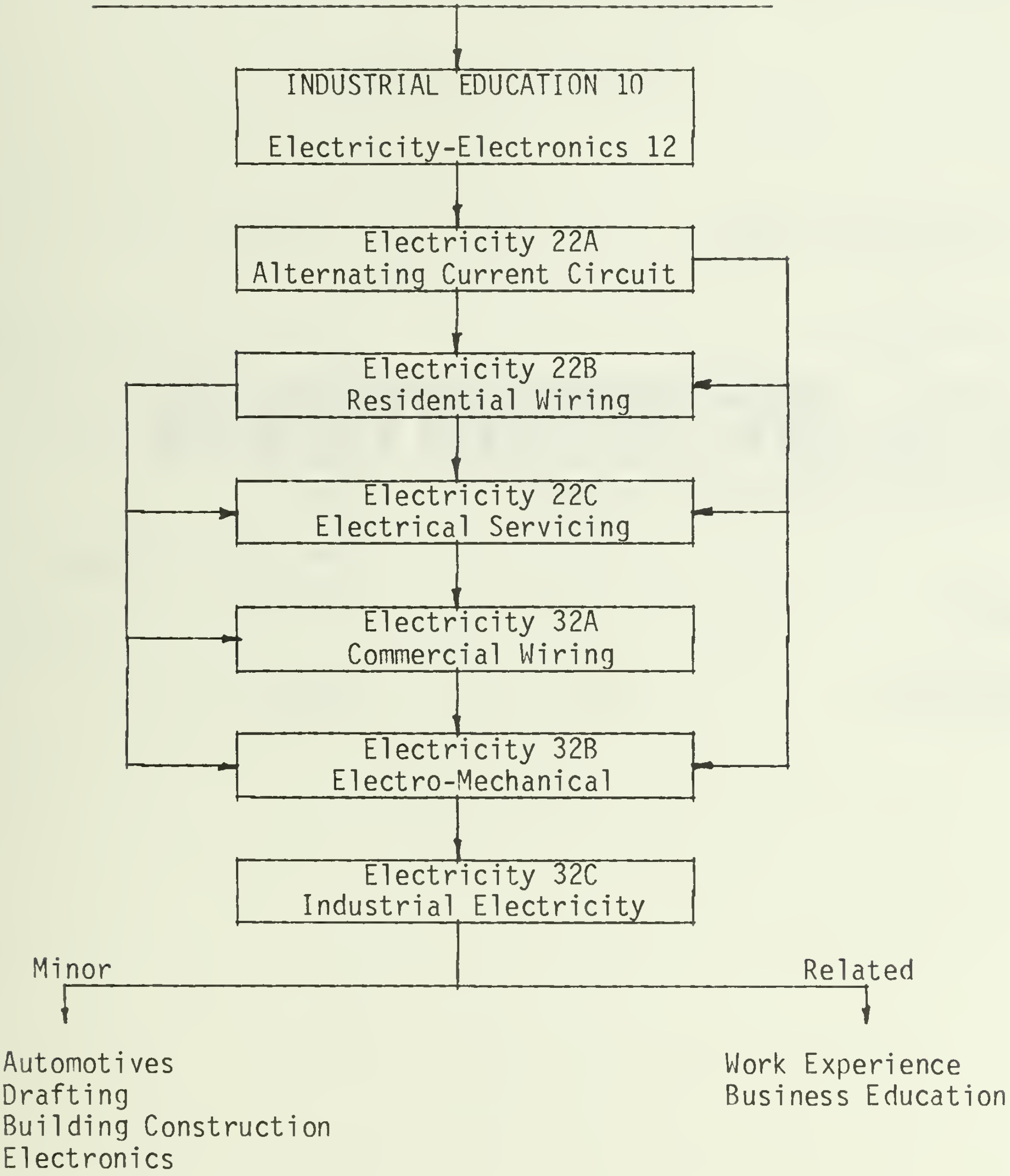
3. one half of a "12" course. The other half would be another half "12" or a module from the "10" program. The course would be recorded as Industrial Education "10".

Following the introductory course the student may advance to the major area of study by selecting any number of five credit modules from the courses designated as "22" or "32". The scheduling and sequencing of the modules is the responsibility of the local school personnel but must be in accordance with the regulations pertaining to prerequisites.

A student registered in a second or third level course ("22" or "32") is regarded as taking a major in that course area. Having established a major the student may select courses designated as minors and in this way broaden his/her practical skill base in a career field or even several career fields. However, students must complete all the preceding modules in a major series (usually six) before taking the 32C module (exception: Beauty Culture).

CAREER FIELD

ELECTRICITY



CAREER OPPORTUNITIES

Students taking all or most of the modules in the Electricity major may look forward to the following opportunities:

Electricity (35 credits)

Post High School Studies

N.A.I.T. or S.A.I.T.

- Electrical Technology
- Communications Electrician
- Air Conditioning & Refrigeration
- Electrical Engineering Technology

UNIVERSITY

- Engineering
- Education

Career Entry

- Electrical Mechanical Technician
- Apprenticeship
- Journeyman Electrician
- Appliance Serviceman
- Power Electrician
- Foreman
- Shop Owner
- Electrical Draftsman
- Salesman

- Engineer
- Teacher

ELECTRICITY 12

COURSE CONTENT

ELECTRICITY - ELECTRONICS 12 (5 CREDITS)

(COMMON MODULE)

INTRODUCTION

The introductory Electricity-Electronics course is a five credit course which leads into either electricity or electronics.

OBJECTIVES

The objectives of Electricity-Electronics 12 are:

1. To provide students with an orientation to the technical and industrial environment.
2. To provide students with information about opportunities in the fields of electricity and electronics.
3. To provide students with the electrical theory required to advance to other related courses.

REFERENCES

*Long, G., Intermediate Electricity, 2nd Edition General Publishing Co.

Miller, R. and Culpepper, F.W. Energy: Electricity/Electronics Gage Publishing Co.

Zbar, P.B. Basic Electricity: A Text Lab. Manual McGraw-Hill Ryerson.

*Refers to Primary Text.

CONTENT SUMMARY:

1. Career fields
   - occupational information
2. Safety, first aid, use of hand and power tools
3. Electricity
   - definition and sources
4. Conductors and insulators
5. Magnetism and electromagnetism
6. Electrical units, measurement, circuits, diagrams and laws
7. Making connections electrical circuits
8. Systems study and project work
   - audio
   - electrical distribution
   - generation plants
   - broadcast receiver
   - others that are appropriate

TOPIC 1: CAREER FIELDS VE12

GENERALIZATION: Occupational information and a knowledge of employment in the Electricity-Electronics career field will help the student determine his educational and vocational endeavors.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
1. Occupational Information:	The student will:	4	Occupational information and films to show types of careers available.
- Awareness of employment opportunities	- search out job opportunities, basic requirements and determine interest to help plan high school program.		
- Future opportunities	- given more information on course content, outline the vocation he/she would like to prepare for		
	- list the opportunities within a career field - installer, electrician, technician, technologist, engineer, mechanic, serviceman		
- Articulation	- explain how this program articulates with requirements of other institutions		

NOTES:

TOPIC 2: SAFETY, FIRST AID, USE OF HAND AND POWER TOOLS VE12

GENERALIZATION: Safety is of prime importance to the well being of persons and the protection of equipment.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:	4	O.H. & S. Films.
1. Unsafe Act	- list the consequences of unsafe acts in Electricity-Electronics as they relate particularly to: - live circuits - excessive current - improper grounding - poor connections		O.H. & S. Posters. "Alive Personnel" "Electricity - Handle with Care film avail. from Power Co.
2. Unsafe Condition	- discuss how to identify conditions which could lead to injuries on the job		
3. Safety Standards and Codes: - Federal - Provincial - Local	- learn safety standards and codes as the need arises		IAVEC - ATA Safety Pub. See Unsafe Acts and Conditions
	- perform experiments in compliance with the electrical code		IAVAC - ARA Reference to publication on safety.
	- demonstrate procedure for fuse replacement, circuit breaker reset, thermo cutout reset		
4. First Aid	- study the correct procedure to remove a person from a line and administer artificial respiration		First Aid Films. St. John's Personnel. Fire Dept. Personnel.
	- study the symptoms and treatment for a person in shock		Ind. Educat. Publications
5. Hand and Power Tools	- disassemble, assemble and construct electrical/electronic circuits using: various screw drivers, pliers, saws, drills, soldering irons		Elect. and Electronic Publications Discarded Devices & Appliances

TOPIC 3: ELECTRICITY

GENERALIZATION: A knowledge of what electricity is, nature of its behavior and sources of it is basic to observing and understanding the electrical phenomenon.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:	2	
1. Electricity	- define static and dynamic electricity and demonstrate the law of charges - describe the nature of a charge from the structure of the atom and charged atoms - differentiate between static and dynamic electricity - define and differentiate between AC and DC		
2. Sources of E.M.F.	- given the necessary equipment, demonstrate six basic sources of E.M.F. and the nature of electrical energy produced - AC or DC		

NOTES:

TOPIC 4: CONDUCTORS AND INSULATORS VE12

GENERALIZATION: Control and behavior of current is determined by the nature and condition of current path.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:	1	
1. Conductors	- define conductors in terms of: - ease of current flow - atomic structure		
	- discuss the effects of lengths, diameter, material and temperature on the conductivity of conductors		
2. Insulators	- define insulators in terms of: - ease of current flow - atomic structure		
3. Semiconductors	- distinguish among conductors, semiconductors and insulators in terms of: - ease of current flow - atomic structure-number of electrons in outer orbit		

NOTES:

TOPIC 5: MAGNETISM AND ELECTROMAGNETISM VE12

GENERALIZATION: Magnetism and electromagnetism are basic to motor action induction and generator action.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:	4	
1. Magnetism	- explain why an iron bar can be magnetized: - electron theory - domain theory		
2. Electromagnetism - the magnetic effect of current	- memorize the laws of attraction and repulsion, explain: - that associated with current there is a magnetic field - the polarity of this field can be determined by the Left Hand Rule		
	- define an electromagnet and explain what determines its strength		
	- make a simple electromagnet		
	- determine the magnetic polarity of a current carrying coil		
3. Motor Action	- discuss motor action		
4. Induction	- explain induction		
	- give examples of electromagnetic induction, motor, generator, transformer		
5. Generator Action	- discuss generator action		

NOTES:

TOPIC 6A: ELECTRICAL UNITS, MEASUREMENT, DIAGRAMS, CIRCUITS AND LAWS

GENERALIZATION: The volt, ohm, ampere and watt are basic in component and circuit measurements.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:	80	
1. Volt - Unit of electrical pressure	- use a volt-meter to measure voltage (Potential difference, emf, electrical pressure) - measure the voltage of cells, cells in series and parallel as power supplies and batteries measure variable power supply outputs and voltage drops		
2. Ohm - Unit of electrical resistance or opposition	- demonstrate: - how to read color coding of resistors - how to use an ohmmeter - how to use an ohmmeter as a continuity checker		
3. Ampere - Unit of electrical current flow	- learn precautions to be observed to safeguard the ammeter - use an ammeter to measure current flow		
4. Prefixes - Micro, Milli, Kilo, Mega.	- use milliammeters and megohmmeters		
5. Watt - Unit of electrical power	- use and identify a wattmeter and study its hook-up		
6. Energy - Kilo-watt - Hours mega joules	- read domestic Kilowatt hour meter at home over an interval of time. Find out cost of consumption over this interval of time		

TOPIC 6B: ELECTRICAL UNITS, MEASUREMENT, DIAGRAMS, CIRCUITS AND LAWS

GENERALIZATION: The basic parts of an electrical circuit, their arrangement and condition of current path governs operational conditions of the circuit by certain relationships.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Basic circuit - has five main parts	- name the main parts of an electrical circuit and give the function of each part: source, conductors, load, control device, protective device		
2. Types of Circuits	- define: - series - parallel - complex circuits in terms of number of current paths		"Basic Elec. - A Text Lab Manual" Zbar, P.B.
	- set up different kinds of circuits using open wire circuitry to demonstrate and compare differences in circuit component arrangements and paths for current to follow		
	- sketch and define an open circuit and a short circuit		
	- with the aid of a schematic diagram, determine circuit operation or non-operation		
	- examine various circuit conditions with open, closed or shorted circuitry		

NOTES:

TOPIC 6C: ELECTRICAL UNITS, MEASUREMENT, DIAGRAMS, CIRCUITS AND LAWS VE12

GENERALIZATION: Electrical components are represented by symbols that are used in diagrams.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Symbols	- draw circuit diagrams given the symbols of the parts and components - read and explain the component arrangements in the circuit by using a schematic diagram, e.g. series, parallel, etc.		
2. Diagrams - Pictorial - Schematic - Line	- identify the following types of diagrams and explain their uses: - pictorial - floor plan - schematic (block) - using basic components, wire a circuit from a schematic		

NOTES:

TOPIC 6D: ELECTRICAL UNITS, MEASUREMENT, DIAGRAMS, CIRCUITS AND LAWS VE12

GENERALIZATION: Electrical circuits are governed by electrical laws and expressed in formulas.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Ohm's Law	- explain the effect on the current in a circuit if the resistance is varied (voltage constant), and effect on current with voltage varied if resistance is constant - using Ohm's law calculate the current, voltage or resistance in electrical circuits $I= \frac{E}{R}$ - set up experiments to demonstrate the effects on the current of varying E or R		
2. Kirchhoff's Laws	- interpret and explain Kirchhoff's Law of current and voltage - differentiate these laws as they apply to series and parallel circuits - define and calculate power consumption or dissipation by using the power formulas: $P = EI$, $P = I^2R$, $P - \frac{E^2}{R}$ - discuss, demonstrate and calculate the wattage of electrical components		

NOTES:

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
3. Circuit Analysis: - Series Circuits	- memorize that: - I is the common component $I_T = I_1 = I_2$, etc. - Total resistance is the sum of the resistors $R_T = R_1 + R_2 + R_3$, etc. - sum of the voltage drops = applied voltage $E_T = E_1 + E_2 + E_3$, etc.		
- Parallel Circuits	- memorize that: - E is the common component $E_T = E_1 = E_2$ - total line current is the sum of the branch currents $I_T = I_1 + I_2 + I_3$, etc. - total resistance is the reciprocal of the sum of the reciprocals $R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}, \text{ etc.}}$		
- Complex Circuits	- identify similarities of both series and parallel circuits and their relationship within one circuit		

NOTES:

TOPIC 7: MAKING OF CONNECTIONS IN ELECTRICAL CIRCUITS VE12

GENERALIZATION: Soldering is a common method used for making connections in electrical circuits.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Soldering	- define soldering		
	- make three common splices, that are mechanically and electrically strong; solder these splices, solder flat surfaces to flat surfaces, solder wire to flat surfaces		
	- apply the proper technique in un-soldering		
2. Solderless connectors	- make several connections using different types of solderless connectors	4	
	- complete basic wiring using solderless connectors in series-parallel circuitry		
	- use doorbell, button mounted on board, 10 volts AC from power supply		NMSC - House Wiring Circuits
	- use knife switches mounted on board, 10 volt lamps, 12 volts DC from power supply		
	- use tri-light switch mounted on board, 12 volt lamps		
	- use appliance switch mounted on board, using 12 volt lamps instead of elements		

NOTES:

TOPIC 8: SYSTEMS STUDY AND PROJECT WORK VE12

GENERALIZATION: Electrical and Electronic systems incorporate many concepts to perform specific functions. Sum total of circuits working together to perform a specific function is a system.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	(Student should study a minimum of four of the systems outlined below.)	22	
1. Audio:	The student will:		
- Transducers	- convert sound waves to electrical waves prior to amplification		
- Amplifiers	- explain the basic theory of operation of a microphone, headphones and speakers		
	- explain the basic theory of operation of a Hi-Fi system and the function of each unit		
2. Electrical Distribution Systems	- explain power distribution to substations		
	- differentiate between the needs and hardware requirements in residential wiring		
	- discuss common electrical faults		
3. Generating Plants	- study the different methods of commercial production of electricity		
4. Broadcast Receiver	- with the aid of a block diagram, explain the function of each unit within the receiver system		

NOTES:

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	- trace the signal through the receiver system and compare inputs and outputs of the units		
5. Broadcast Transmitter	- explain the basic principles of establishing a carrier using the block diagram approach to a basic transmitter - explain modulation - explain the function of each unit, inputs-outputs, principles of operation, energy transformation, transmission and wave propagation		
Other systems which could be studied: - Electrical Appliance - Electric Motor - Digital Device - Television Receiver			
6. Projects	- assemble suitable projects such as circuit testers, motor speed control, light organ, etc.		
		125	

NOTES:

ELECTRICITY 22A

COURSE CONTENT

ELECTRICITY 22A (5 CREDITS)

INTRODUCTION

The course is designed to give the students sufficient skill and knowledge to be able to effectively achieve in subsequent courses in Electricity.

OBJECTIVES

The objectives of Electricity 22A are:

1. To provide background in the basic principles of active and reactive circuits including their application.
2. To provide opportunities to develop skills in the use of test instruments that apply to active and reactive circuits.

REFERENCES

*Clidero & Sharpe, Applications of Electrical Construction (2nd Ed.) General Publishing.
Duff, J.R. Lab. Experiments - Delmar Publishers.
Lister, E.C. Electric Circuits and Machines McGraw Hill Ryerson.
Miller, R. and Culpepper, F.W. Energy: Electricity/Electronics Gage Publishing Co.
Zbar, P.B. Basic Electricity - A Text-Lab Manual McGraw-Hill Ryerson.

*Refers to primary text.

CONTENT SUMMARY

1. Alternating voltage and current
   - A.C. power-generation
   - audio and radio signals
2. Inductance
3. Capacitance
4. Capacitive reactance
5. Capacitive circuits
6. Alternating current circuits
7. Semi-conductor and vacuum tube diode
8. Power supplies

TOPIC 1: ALTERNATING VOLTAGE AND CURRENT VE22A

GENERALIZATION: Alternating current and voltage are used in AC power, audio, radio signals and induction.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		"Basic Elec. - A Text-Lab Manual" Zbar, P.B.
1. AC Power	- learn the operation of an oscilloscope - complete an experiment to show how an AC sinewave of E or I is generated		"Lab. Experiments: Alternating Current Fundamentals" Duff, J.R.
2. Audio and Radio Signals:	- distinguish between audio and radio frequencies - observe, and analyze an AC waveform, e.g. frequency, period, wavelength, angular velocity, phase angle - list the different sources of AC signals - power, AF and RF generators		"Electric Circuits & Machines" Lister, E.C.
3. Compare AC to DC in producing power	- interpret RMS Value, peak-value, peak-to-peak values and amplitude of an AC source; also, draw and label a sinewave		
4. Ohm's Law and Power Formulas Apply Directly to AC Circuits with R only.	- Make calculations in AC electrical circuits		
5. Kirchoff's Laws	- state Kirchoff's Laws and analyze circuits by use of Kirchoff's Laws - conduct experiments related to Kirchoff's Laws		

GENERALIZATION: The ability of a coil to induce a voltage and oppose current has a much more profound effect on the E and I in AC circuits than it does in DC.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Inductance - of a Coil	- explain how the opposition to change is produced - define the units of - inductance - henry - self-inductance - henry - mutual inductance - henry - find L_T of: - series connected inductances - parallel connected inductances		
2. Phase - Inductance	- demonstrate the effect of L in electrical circuit, - oppose change in I - cause I to lag E by 90° using Dual Trace Scope - draw the I and E waveforms and phasors for circuits		
3. Inductive-Reactance	- calculate the opposition to AC - explain how opposition to AC is produced by the Back emf or counter emf of self inductance - calculate inductive reactances in series and parallel - make calculations relative to reaction currents and voltages		

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
4. RL Circuits	- draw the waveforms and phasor for I and E - use the voltage triangle - use the impedance triangle - show how R affects current in a series RL circuit and in a parallel circuit - perform experiments to verify voltage, current impedance and power relationships in a series and parallel RL circuit		
5. Coils	- explain when a coil is considered to be a choke		
6. Transformers	- explain the three uses of transformers: - step-up - step-down - isolation		

NOTES:

GENERALIZATION: Capacitance is the ability of a component or circuit to store an electrical charge.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Capacitors	- define a capacitor - define an electrostatic field - differentiate between different types of capacitors e.g. air, paper, mica, electrolytic, etc. - use the color code for capacitors - identify the factors that determine: - area of plates - distance between plates - nature of dielectric		
2. Testing	- use a VOM for testing for shorted or leaking capacitors		
3. Capacitors in Circuits	- perform experiments to verify the effect of capacitance in series and parallel		

NOTES:

TOPIC 4: CAPACITIVE REACTANCE

VE22A

GENERALIZATION: The opposition to AC by a capacitor, is capacitive Reactance $X_C = \frac{1}{2 \quad f C}$.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Capacitive Reactance	- learn by experimentation how opposition to AC is produced by the charge and discharge of a capacitor		
	- explain capacitive reactance in parallel and series		
	- make calculations relative to reactive currents and voltages		

TOPIC 5: CAPACITIVE CIRCUITS

VE22A

GENERALIZATION: A capacitor is charged when a voltage source is used to move electrons from one of its plates to the other.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. RC Circuits	- draw the waveforms and vectors for I and E		
	- use the voltage triangle		
	- use the impedance triangle		
	- show the effect of C in a series and parallel circuit		
2. Time Constant	- demonstrate the charging and discharging rate of a RC circuit		

TOPIC 6: ALTERNATING CURRENT CIRCUITS VE22A

GENERALIZATION: Reaction of coils and capacitors to AC is fundamentally different from reaction to DC.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. RLC Circuits	- with the use of vectors, demonstrate the opposite effects of L and C		
	- explain and calculate Z for series and parallel circuits		
	- distinguish among, real power, apparent power, reactive power (W, VA, VAR)		
2. Resonant Circuits - series - parallel	- demonstrate impedance at resonance in series and parallel		
	- demonstrate that at resonance the effects of L(X_L) and C(X_C) cancel leaving only R in the circuit		

NOTES:

TOPIC 7: SEMI-CONDUCTOR AND VACUUM TUBE DIODES VE22A

GENERALIZATION: Diodes are fast acting electronic switches with controlled conduction, conducting only when forward biased and used in detection, rectification, switching, limiting and regulations.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Semi-conductors:	- explain the electrical properties of a semi-conductor		
- Doping	- explain the need for doping to produce extrinsic semi-conductor material		
- PN Junction Diode	- explain the formation of a diode		
- Biasing	- explain Low-High resistance with forward and reverse bias		
	- given an ohmmeter, measure back-to-front resistance ratio and state quality of device; test semi-conductor diodes on a diode tester		

NOTES:

TOPIC 8: POWER SUPPLIES VE22A

GENERALIZATION: Power supplies convert AC to DC through rectification, filtering and regulation.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Rectification	- explain how a diode can be used as a rectifier and explain: - how a half-wave rectifier operates - how a full-wave rectifier operates		
	- given components and schematic assemble each rectifier in turn		
2. Filtering	- observe the effects of filtering on DC output		
	- compare the effectiveness of various filter arrangements		
	- compare filtering effects of half-wave and full-wave rectification		
3. Regulation	- define regulation and distinguish between good and poor regulation		

NOTES:

ELECTRICITY 22B

COURSE CONTENT

ELECTRICITY 22B (5 CREDITS)

(RESIDENTIAL WIRING)

INTRODUCTION

Electricity 22B introduces the student to basic residential wiring. The introductory course, Electricity-Electronics 12, or Industrial Education 10 and Electricity 22A are pre-requisites.

OBJECTIVES

The objectives of Electricity 22B are:

1. To introduce the students to concepts of electrical wiring in the home.
2. To allow the students to develop skill in the use of tools, equipment, and instruments peculiar to the electrical field.
3. To familiarize the students with the electrical codes and their application.

REFERENCES

*Canadian Electrical Code, Current or latest approved Ed. C.S.A.

*Clidero & Sharpe, Applications of Electrical Construction 2nd Ed. General Publishing.

Miller, R. and Culpepper, F.W. Energy: Electricity/Electronics Gage Publishing Co.

*Refers to Primary Text.

CONTENT SUMMARY

1. Career opportunities
2. Safety
3. Residential Wiring Installations
   - planning
   - installation
   - re-wiring
4. Management Practices
   - organization
   - bidding for work
   - employee concerns

TOPIC 1: CAREER OPPORTUNITIES IN ELECTRICITY VE22B

GENERALIZATION: A knowledge of the career opportunities in electricity will help the student make a more rational choice of school courses that prepare him for a future job.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. The Career: - residential wiring is only a small facet of the electrical field	- investigate the career opportunities in the electrical field by: - listing the number of residential starts in the province - interviewing electrical contractors to determine hours/start		Discussion. Career film. Visit by power co. official Government publications
- commercial wiring must be taken to be eligible for "time-off" on apprenticeship	- study the Apprenticeship Act of Alberta and list its requirements		Lecture/ Discussion with aid of government brochures

NOTES:

TOPIC 2: SAFETY

GENERALIZATION: Safety is of prime importance to the well being of persons and equipment.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Unsafe Act	- list the consequences of acts in electricity particularly as they relate to: - electric wires - earth		
2. Unsafe Condition	- discuss how to identify conditions which could lead to injuries on the job - identify common electrical faults		
3. First Aid	- perform artificial respiration - treat for shock		

NOTES:

TOPIC 3: RESIDENTIAL WIRING INSTALLATIONS VE22B

GENERALIZATION: The function of residential wiring is to provide safe and sufficient power distribution in the home.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Planning	- given a variety of floor plans of rooms and structures locate power and lighting outlets and control stations using electrical symbols		Calgary Power Guide Code Section #26 & #2.
2. Installation	- through a series of graduated exercises from wiring boards and mock-ups through projects of basement development, renovations, garages, cabins and houses, install all common electrical materials and devices, such as: boxes, conductors, NMS, raceways, services, lighting, heating, smoke detectors		#2, #3, #4, C & S. #7, C & S CEC #12. #5, C & S CEC #4. #14 C & S. #8 C & S. #15, C & S, CEC #6. #18, C & S, CEC #30.
3. Rewiring	- add outlets and control stations to finished structures		Calgary Power, Northwestern Utilities Publications

NOTES:

TOPIC 4: MANAGEMENT PRACTICES VE22B

GENERALIZATION: An understanding of relationships between employer and employee, unions and management and regulations that bind both is essential to help all concerned meet their responsibilities.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Business Organization and Procedures	- discuss different types of businesses, laws that regulate them and some advantages/disadvantages of each - discuss the methods of invoicing, stock taking, billing and collecting tardy accounts		Government pamphlets Business forms
2. Bidding on work	- given a variety of rooms and structures, prepare an accurate bid using i) detail take-off sheets ii) contractor's estimate forms		Supplier catalogues, price sheets, contractors forms
3. Employee Concerns:			
- The interests of the worker are protected by various means. Legislation.	- discuss the responsibilities in contributions towards U.I.C., pension, medical		Union brochures, union representatives
- Employee groups	- discuss the various employee groups, advantages and disadvantages and his/her expectations		
	- demonstrate knowledge of Worker's Compensation Board Regulations and procedures		Worker's Compensation Board publications

ELECTRICITY 22C

COURSE CONTENT

ELECTRICITY 22C (5 CREDITS)

(ELECTRICAL SERVICING)

INTRODUCTION

Electricity 22C is a five-credit module in Electrical servicing.

OBJECTIVES

The objectives of Electricity 22C are:

1. To provide the students with skills in troubleshooting electrical appliances,
2. To provide students with servicing skills.

REFERENCES

*Clidero R.D. & Sharpe K.H., Applications of Electrical Construction General Publishing Co.

Miller, R. and Culpepper, F.W. Energy: Electricity/Electronics Gage Publishing Co.

*Refers to Primary Text.

CONTENT SUMMARY

1. Occupational information
2. Service equipment
   - care and use of hand tools and meters
   - finding service information
3. Troubleshooting
   - safety
   - cleaning appliances
   - procedures for finding problems
4. In-servicing procedures
5. Servicing domestic appliances
6. Estimating and pricing
7. Service factors

TOPIC 1: OCCUPATIONAL INFORMATION VE22C

GENERALIZATION: There are several factors to consider in becoming a tradesman.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Trained service personnel have choices where they may work	- discuss the ways in which he/she may use his/her talents		
2. Working as an employee	- list the advantages and disadvantages of working for an appliance firm in this city		
3. Operating a Private Business	- list the pros and cons for a private business		
4. "Do it yourself competition"	- discuss the implications of the "do it yourself" age		

NOTES:

TOPIC 2: SERVICE EQUIPMENT VE22C

GENERALIZATION: A knowledge of the use and handling of service equipment is basic to the electrical service man.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Care and organization of equipment is necessary for successful work:	- given a set of equipment, organize it and take care of it		
- Hand Tools	- given the required hand tools, use the tools for specific purposes explained by the teacher: - screwdrivers - wrenches - pliers - other		
- Meters	- given a variety of meters, demonstrate their functions: - voltmeter - ammeter - ohmmeter		
- Specialized equipment	- given specialized equipment (iron temperature testing stand, timer tester, specific assembly tools), use them for their designed purposes		
2. Service Information	- given any appliance for repair find pertinent service information		Use a service text

NOTES:

TOPIC 3: TROUBLESHOOTING VE22C

GENERALIZATION: A knowledge of troubleshooting is basic in servicing.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Safety Review:			
- Unsafe Act	- list the consequences of unsafe acts in appliance servicing as they relate to: - live circuits - overloading - instrument use - grounding procedures - lifting		
- Unsafe Condition	- discuss how to identify conditions which could lead to injuries on the job		
- First aid	- perform artificial respiration		
2. Cleaning Appliances	- explain the destructive role of dirt in mechanical breakdown		
	- inspect and clean a toaster (or other appliance)		
3. Circuit Failures	- given an appliance, test for circuit continuity		
	- repair faulty circuits		
4. Material Failures	- given the names of commonly used materials for manufacturing appliances and insulation, identify probable locations of breakdowns		
5. Other causes of Failure	- discuss and list contribution factors to appliance failure		

NOTES:

TOPIC 4: PROCEDURES IN SERVICING VE22C

GENERALIZATION: There is a logical sequence that should be followed in servicing.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Service Records	- record all the data he/she requires in a repair operation		
2. Dismantling	- given any appliance, dismantle it in accordance with a standard procedure		
3. Cleaning	- clean any given appliance		
4. Adjusting	- given an appliance that needs only adjusting, perform the required operation		
5. Repairing	- make repairs on power cord and explain		
6. Replacing	- explain when to repair and when to replace		
7. Reassembling	- after he/she has disassembled an appliance, assemble it according to the standard procedure		
8. Testing	- test a repaired appliance		

NOTES:

TOPIC 5: SERVICING DOMESTIC APPLIANCES VE22C

GENERALIZATION: Appliances must be serviced at regular intervals for optimum performance and life expectancy.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Small Appliances	- overhaul and/or repair a variety of small appliances e.g. hair dryers, curling irons etc.		
2. Major Appliances: - Range - Washer - Dryer	- repair or dismantle and assemble the electrical circuitry in the appliance, thereby gaining a basic understanding of: - operating features and/or cycle - schematic diagrams - safety devices such as interlock, overload, limit switches, etc. - functions of components such as elements, switches, timers, thermostats, fuses, breakers, lighting, solenoids, motors, sensors, relays, etc.		

NOTES:

TOPIC 6: ESTIMATING AND PRICING

VE22C

GENERALIZATION: A knowledge of estimating and pricing is necessary in servicing.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Overhead Expenses	- list the costs that go into overhead expenses		
2. Parts Mark-up	- discuss why a part cannot be sold at the invoice price		
3. Cost of Labour	- compare estimated time with actual time for a variety of repair services		
4. Service Charge	- explain why a service charge is made		
	- indicate the service charges made in other occuptions		

TOPIC 7: SERVICE FACTORS

VE22C

GENERALIZATION: A knowledge of the service factors is a definite asset for optimum appliance servicing.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Distribution Centres	- list suppliers for various brand name appliances and parts		
2. Manufacturers Policies	- discuss warranty policies		
	- identify situations in which service or repair parts are unavailable or uneconomical and analyze the underlying causes		
3. Trade Names	- discuss the interchangeability of parts		

ELECTRICITY 32A

COURSE CONTENT

ELECTRICITY 32A (5 CREDITS)

(COMMERCIAL WIRING)

INTRODUCTION

The module in Commercial Wiring may be in sequence or students may advance to it directly from Electricity 22B.

This course could be taught in almost any electricity lab or shop, but could best be done in one equipped with a large wooden "mock-up" structure with open frame and sheeted walls on which a variety of electrical installations can be placed. Use of "heavy construction" areas or "pipe trades" areas would be advantageous. It is expected that the instructor would provide about half of the time for practical work for his students, with remaining time devoted to discussion of wiring practice, theory and related code.

Time allotted for each topic area is approximate and would vary with types of equipment (e.g. heating system) available.

No expensive equipment is required for this course, although supplies of conduit and wire, which have limited re-use possibilities, may be fairly extensive.

OBJECTIVES

The objectives of this course are:

1. To provide the students with fundamental skill and knowledge required in electrical construction and to familiarize them with tools, fittings and equipment used in industry.
2. To provide a background of Electrical Code regulations so that students may understand the reason for various restrictions and regulations and so that they may develop a standard of performance that would enable them to enter the electrical construction field upon completion.
3. To introduce students to the various systems used in providing electrical outlets of all types in large residential, commercial and industrial installations.
4. To familiarize the students with the specialized terminology and equipment of the domestic and commercial heating controls field.

REFERENCES

*Clidero, R.K. & Sharpe, K.H., Applications of Electrical Construction
General Publishing Co.

*Canadian Electrical Code - C.S.A., latest approved edition.

Miller, R. and Culpepper, F.W. Energy: Electricity/Electronics
Gage Publishing Co.

*Refers to Primary Text.

CONTENT SUMMARY

1. Technical drawing
   - plan views dimensioning and symbols
2. Wiring methods
   - raceways and conductors
   - tools and equipment
   - fittings and boxes
3. Installation of services and feeders
   - service entrance
   - protective equipment
   - metering equipment
4. Control equipment
5. Installation of lighting equipment
   - lighting equipment
   - special equipment
6. Heating controls

TOPIC 1: TECHNICAL DRAWINGS VE32A

GENERALIZATION: Provincial and Municipal regulations require detailed sets of drawings, building plans and wiring diagrams.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Electrical Blueprint Reading: - symbols - dimensioning - scales - views	- study and draw blueprints ranging from single circuits to complete commercial installation - attempt take-offs and estimates of commercial jobs - review and study, Edison 3 wire system and 30 4 wire system		Contractors blueprints. Existing school blueprints. C & S, #1, #16.
2. Architectural Drawing	- use architectural drawings as they apply specifically to an electrical installation		
3. Mechanical Drawings	- use mechanical drawings as they apply specifically to electrical installation - interpret the drawings to obtain complete information regarding location and installation of an electrical system		

NOTES:

TOPIC 2: WIRING METHODS VE32A

GENERALIZATION: The student must follow approved methods when installing electrical circuits.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Raceways	- install both E.M.T. and Rigid Conduit on wiring boards - connecting lights, receptacles and controls		C & S, #8, #11, #12, #13, #14.
2. Fittings and Boxes	- discuss common box numbers, standard, weather proof and explosion proof		C & S, #7, code sections #12
3. Conductors	- calculate capacities and raceway sizes		Commercial catalogues code section #18.
4. Tools and Equipment	- use hand tools, taps and dies, drills		
	- use benders, vices		Code section #4, #12. C & S, #5, #8.
	- be given a demonstration of an explosive actuated tool		Catalogues and Advertising brochures, C & S #21.

NOTES:

GENERALIZATION: Proper service size, conduit, conductors, panels, breakers must be calculated for each commercial or residential installation; and code regulations must be followed.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Services	- discuss various approved methods for overhead and underground services		C & S, #16, code section #6, #8.
	- calculate service size, and list all the fittings required for: - residences - apartments - schools, etc.		
2. Metering	- discuss different sizes as to: - amperages - voltages - systems - use of current and voltage transformers		
3. Protective Equipment	- use various types of fuses and breakers		Catalogues C & S, #17.

NOTES:

TOPIC 4: CONTROL EQUIPMENT VE32A

GENERALIZATION: Installation of motors and controls require a thorough understanding of motor protection devices and a knowledge of control circuits.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
1. Control and Protection	The student will: - connect various magnetic switches and starters: - 1 phase - 3 phase - 2 speed - reversing - calculate overload sizes and recognize devices		C & S, #20. Manufacturers catalogues

TOPIC 5: INSTALLATION OF LIGHTING EQUIPMENT VE32A

GENERALIZATION: Correct installation of lighting equipment requires an understanding of specific code sections and installation procedures.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
1. Lighting Equipment: - residential - commercial	The student will: - install incandescent fluorescent and vapour fixtures		C & S #19 Code Section #30 and 26.

NOTES:

GENERALIZATION: Heating systems require a variety of low voltage controls to maintain proper temperature and ventilation and to provide safety from gas or steam explosions.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Systems: - forced air - hot water - steam	- study operation and set up systems using: - 24V transformer - powerpile - thermostats - limit switches		C & S, #10. Manufacturers catalogues

NOTES:

ELECTRICITY 32B

COURSE CONTENT

ELECTRICITY 32B (5 CREDITS)

(ELECTRO-MECHANICAL)

INTRODUCTION

This module on Electro-Mechanical Systems may be taken following completion of Electricity 22C.

This course will provide a helpful background for the student planning a career in the apprenticeship area, if taken in conjunction with, or in sequence with the residential and commercial wiring courses.

OBJECTIVES

The objectives of this course are:

1. To introduce the students to all forms of rotating electrical machinery including the principles of operation and electrical theory and calculations.
2. To provide the students with opportunities to work with large and small A.C. and D.C. generators and motors and to gain an understanding of the characteristics of each by a series of experiments and work projects.
3. To provide the proper technical skill and knowledge for those students who may decide to proceed further into the challenging field of electrical technology. This course should enable students to find out if they have the ability and interest to proceed in a technology.

REFERENCES

*Clidero, R.K., & Sharpe, K.H., Applications of Electrical Construction General Publishing Co.

Duff, J.R. Lab Experiments Delmar Publishers.

Miller, R and Culpepper, F.W. Energy: Electricity/Electronics Gage Publishing Co.

*Refers to Primary Text.

CONTENT SUMMARY

1. D.C. generators
2. D.C. motors
3. A.C. generators
4. A.C. motors
5. Transformers

TOPIC 1: D.C. GENERATORS VE32B

GENERALIZATION: Induced EMF is caused by passing a conductor through a magnetic field.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Generator Construction	- disassemble and reassemble a complete DC generator		"Lab. Exp. - Direct Current Fundamentals" Duff, J.R.
2. Induced EMF	- discuss induced EMF		
3. Commutation	- describe the purpose and operation of commutators		
4. Generator fields:	- connect DC generator fields for separate and self excitation		
- shunt - series - compound	- construct characteristic curves for shunt, series and compound generators		
5. Inter-poles	- connect interpoles on generators and by diagrams, for 2 and 4 pole generators: - clockwise rotation - counter-clockwise rotation		
6. Generator Characteristics	- calculate efficiency of a DC generator given power output and power input		
	- calculate voltage regulation of various DC generators given voltages at varying loads		

NOTES:

TOPIC 2: D.C. MOTORS VE32B

GENERALIZATION: D.C. motors have unique characteristics that are still advantageous over other types of electric motors in certain applications.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Development of torque	- describe the principle of a DC motor - calculate torque, CEMF, etc.		"Lab. Exp. - D.C. Generator Fundamentals" Duff, J.R.
2. Shunt field	- describe shunt field motor		
3. Series field	- list advantages of series field - describe principle of series field motor		
4. Compound motor	- describe compound motor		
5. Armature reaction	- discuss armature reaction		
6. Starters	- connect interpole windings using correct polarity - connect various starters manual and automatic		
7. Speed control	- choose appropriate speed control and make proper connections - connect various motor speed controls, including silicon controlled rectifiers		

NOTES:

TOPIC 3: A.C. GENERATORS VE32B

GENERALIZATION: The A.C. generator is studied as an electrical machine of major importance as well as a means of analyzing sine wave forms of voltage and current.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Two pole basic generator	- disassemble and assemble small generators - examine various types of rotating armature, rotating field		"Lab. Exp. - A.C. Fundamentals" Duff, J.R.
2. Rotating field	- check and examine slip rings and brushes - study various exciter systems and controls		
3. Voltage regulation	- operate alternator - calculate performance, characteristics		
4. Three phase generator	- discuss the three phase generator		
5. Parallel operation of generators	- synchronize two generators - shift load from one to the other - discuss the effect of over-exciting generator when paralleled		

NOTES:

GENERALIZATION: The A.C. motor is studied as an electrical machine of major importance, and also as a means of understanding sine wave forms of voltage and current for single phase and 3 phase systems.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. 3-Phase induction motors	- connect the stator windings of a 3-phase motor in a Y or delta configuration to the line - describe the construction of the stator, rotor endframe, etc. and be able to disassemble and assemble complete motor - reverse the direction of the rotating field - overcome the effects of "single phasing" - explain the torque characteristics of a 3-phase induction motor		"Lab. Exp. - A.C. Generator Fundamentals" Duff, J.R.
2. 3-Phase wound rotor motors	- describe the difference in connection and operating characteristics between squirrel-cage rotors and wound-rotor types - make torque, speed efficiency tests on shop units connected to variable loads		
3. Single phase induction motor	- disassemble and assemble complete unit		

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	- describe split phase principle, purpose and operation of centrifugal switch		
	- draw diagrams of internal parts switches, thermal protection, etc.		
4. Capacitor start split-phase motors	- make proper connections to run and start windings for various types of single speed and dual voltage		
	- record name plate data		
	- operate motor at all name plate speeds and voltages		
5. Special purpose motors: - synchronous	- describe the basic differences in principle and in motor construction between the basic induction motor and the synchronous motor		Hampden and Unelco series 100 lab manuals
	- explain the controls used on the D.C. field of the synchronous motor and the effect on power factor		
-self-synchronous	- apply basic principles of synchronous motor to self-synchronous systems by connecting and operating them		
- shaded pole	- identify the specific type of motor and perform basic trouble-shooting procedures and repairs		
- series or "universal"	- work with various sizes of universal motors; disassemble, etc.; commutator dressing and polishing, brush replacement		

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
- repulsion start	- use growler		
6. Manual and Magnetic Motor Starters	- connect various motor starters, connecting them to single phase and 3-phase motors - draw detailed schematic diagrams of these - reverse starters - calculate size of heater required for proper motor protection - draw schematic diagrams of all of the above		
7. Relays, interlocks, timers and transducers	- connect a variety of control devices to motor circuits which have already been wired to magnetic starters		Hampden

TOPIC 5: TRANSFORMERS VE32B

GENERALIZATION: Mutual induction will cause one coil to induce a voltage in another when they have a common magnetic field.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Ampere turns	- define the concept of ampere turns		

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
2. Voltage and current ratios	- calculate voltages and current using transformer ratios - measure primary and secondary voltage and currents on a loaded transformer - describe principles of transformer losses of large and small transformers - perform tests calculating core losses and copper losses; calculate efficiency		"Lab. Exp. - AC Generators and AC motors" Duff, J.R.

3. Paralleling transformers and transducers	- perform a paralleling operation with two transformers of unknown polarity
	- check transformers for polarity using:
	  - voltmeter
	  - oscilliscope
	  - "kick" test
	- calculate current from each and power rating required of each under specific load		

4. Special purpose transformers	- explain the principle and proper methods of connecting and using:
	  - auto transformer
	  - instrument transformer
	    - current transformer
	    - potential transformer
	  - variable transformer
	  - isolating transformer
	- connect and operate under realistic load, the transformer types listed		

ELECTRICITY 32C

COURSE CONTENT

ELECTRICITY 32C (5 CREDITS)

(INDUSTRIAL ELECTRICITY)

INTRODUCTION

The final module in the Electricity sequence is available to students who have completed 30 credits or six modules in the major.

Instruction time in this module may be used to:

1. Provide greater depth in modules taken previously. Individual students, groups of students or whole classes may elect to study an area in more detail. The in-depth study could be in residential wiring, electrical servicing or any of the other modules listed in the sequence.

2. Engage in actual wiring or electrical repair work by means of a program co-ordinated by the Electricity teacher and under the supervision of a journeyman on the job.

CONTENT SUMMARY

1. Measurement
   - oscilloscope

2. Semi-conductors theory
   - sub-atomic structure

3. Semi-conductor applications
   - power supply
   - transistors

TOPIC 1: MEASUREMENT VE32C

GENERALIZATION: The oscilloscope is widely used as a measuring instrument in the field of electricity.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Oscilloscope	- list the main parts of the CRT - describe how various deflection voltages will affect the spot - define the following terms: time base, sweep, recurrent sweep, triggered sweep - explain the function of oscilloscope controls - use an oscilloscope to measure voltage, time, frequency, and to determine an unknown frequency		

TOPIC 2: SEMI-CONDUCTORS THEORY VE32C

GENERALIZATION: Some of the materials used in electrical components are neither good insulators nor good conductors.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	The student will:		
1. Sub-atomic structure and behavior	- define group IV element, covalent bonding, thermal generation, doping, hole, electron, p-type semiconductor, n-type semiconductor, barrier potential depletion region, majority carrier, minority carrier, intrinsic, extrinsic - describe the effect of forward reverse bias on the carriers in the PN junction		

TOPIC 3: SEMI-CONDUCTOR APPLICATIONS

VE32C

GENERALIZATION: Special components may be used in electrical circuits to control the direction and flow of electrons.

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
1. Power Supply: - Diode - Rectifiers - Single-phase half-wave - Single-phase center-tap - Single-phase bridge - Three-phase half-wave - Three-phase full-wave	The student will: - identify the symbol for a diode and identify anode and cathode - determine if a given diode, in a given circuit, is blocking or conducting - sketch the characteristic curves for silicon and germanium diodes - sketch the circuit - sketch the waveforms of voltage across each part of the circuit and waveform of current in each part of the circuit - show how an oscilloscope should be connected to display various waveforms - calculate average load voltage, diode peak inverse voltage, average diode current, peak diode current, average load current - state the conduction angles of the diodes - describe the effect on load voltage waveform and on other diodes when a diode opens or shorts		

NOTES:

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
- Filters	- sketch the output voltage waveform and diode current waveform for a rectifier with capacitor filter - describe the effect on output voltage waveform of value of C, value of load resistance, frequency of rectifier output pulses - define time constant, ripple, ripple frequency - describe the operation of a choke-input filter in terms of voltage divider action		
- Zener regulator	- describe the constant-voltage action of the back-biased diode in the breakdown region - calculate maximum allowable zener current - describe the circuit action of the zener regulator - calculate the series resistor and the input voltage range over which a zener circuit will regulate		
2. Transistors: - Transistor theory	- explain the concept of transistor action - identify the symbols for PNP and NPN transistors - sketch a circuit diagram to show the correct biasing for PNP and NPN transistors		

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	- apply in simple circuits the following formulas: $I_E = I_C + I_B$ alpha = I_C/I_E beta = I_C/I_B		
- Transistor as a switch	- describe how the basic common emitter circuit acts as a drive for a relay coil, connected in the collector - define saturated, active and cutoff - describe the action of selected transistor switch circuits		
- Transistor as a variable series element	- describe the action of the DC motor base speed up control, using the transistor in series with the field		
- Unijunction transistor (UJT)	- describe the basic construction and theory of operation of the UJT - identify the symbol of the UJT - sketch the equivalent circuit of the UJT - define interbase resistance, intrinsic standoff ratio - sketch the circuit and waveforms for the basic UJT oscillator - calculate the approximate charge-circuit time constant and discharge-circuit time constant		

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	- describe the action of selected UJT circuits		
- Silicon-controlled Rectifier (SCR)	- identify the symbol for the SCR - describe the theory of the device in terms of the two-transistor analogy - sketch the characteristic curve of the SCR - describe the effect of gate current on the characteristic curve - define breakover voltage, holding current, rate effect - list the requirements for turn-on, turn-off - sketch the voltage waveforms in an SCR phase control circuit - describe the action of an SCR motor speed control circuit with the soft-start feature - describe the action of selected SCR circuits		
- Triac	- identify the symbol for the triac - describe the theory of the device in terms of back-to-back SCR's - sketch the characteristic curve of the SCR		

NOTES:

CONCEPTS/SUBCONCEPTS	LEARNING TASKS	HOURS	REFERENCES
	- describe the effect of gate current on the characteristic curve - list the requirements for turn-on, turn-off - sketch the voltage waveforms in a triac phase control circuit - describe the action of selected triac circuits		

NOTES:

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